Visions of the Smart Grid:

Deconstructing the traditional utility to build the virtual utility

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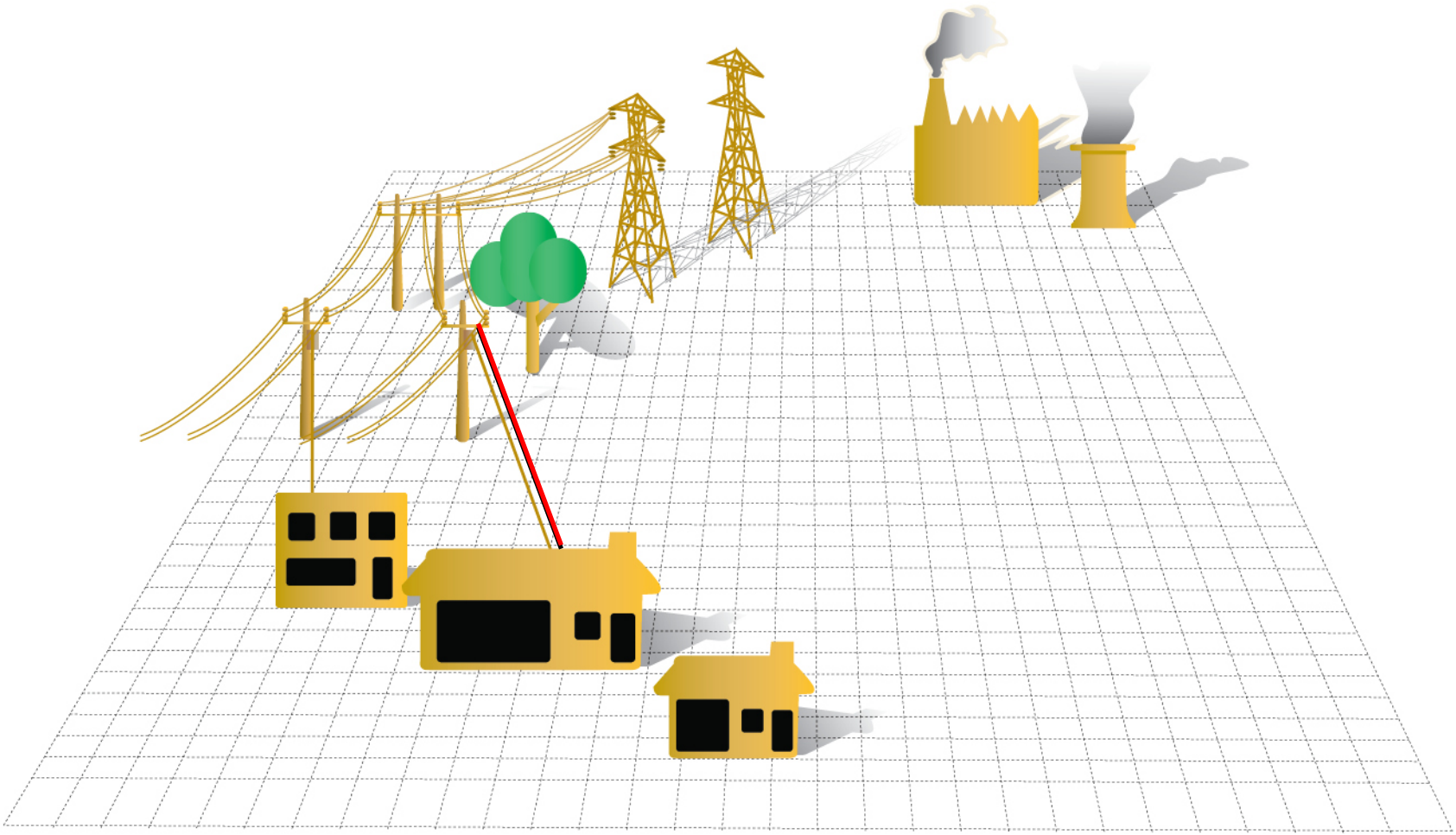
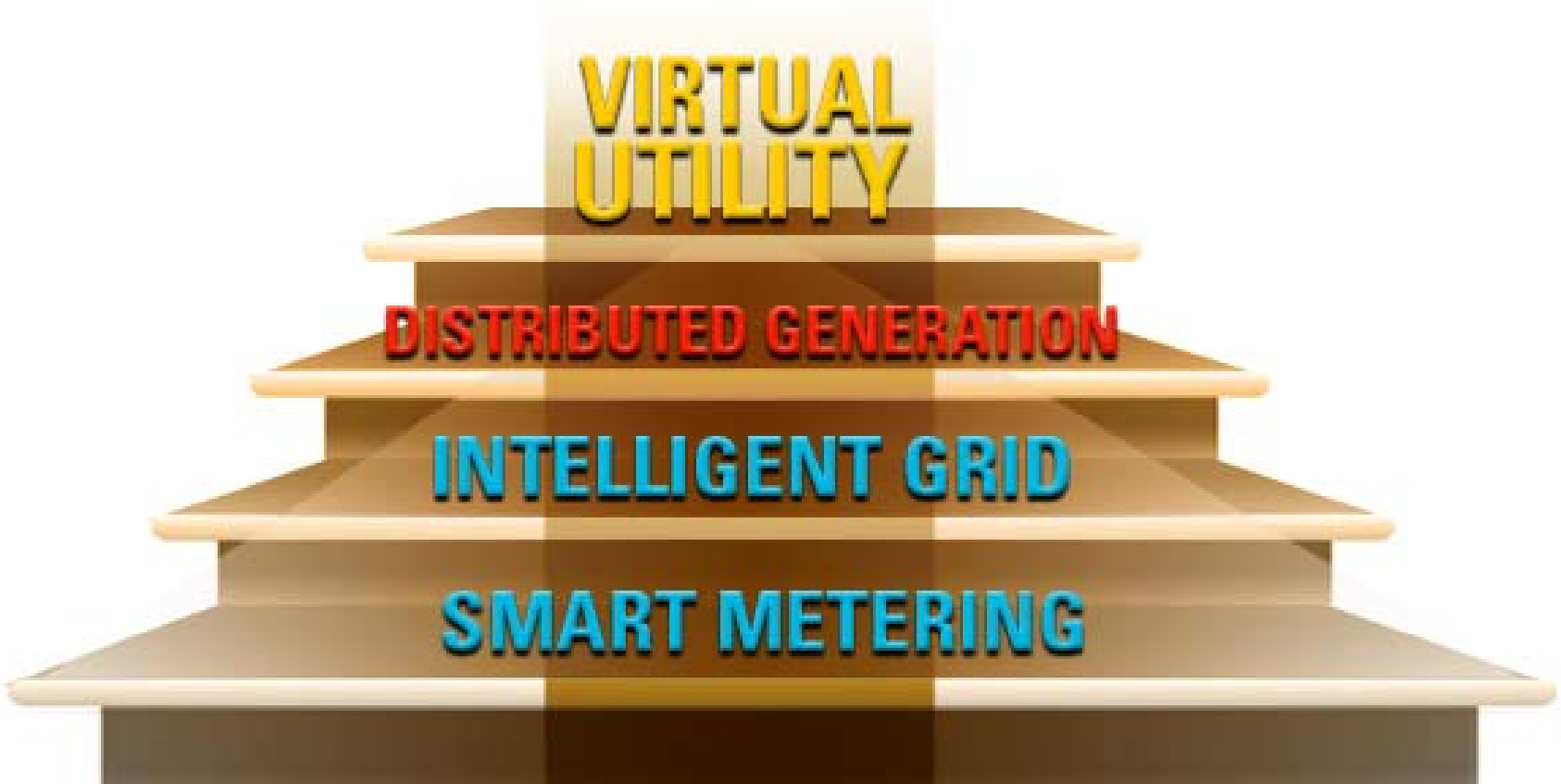
The Traditional Utility

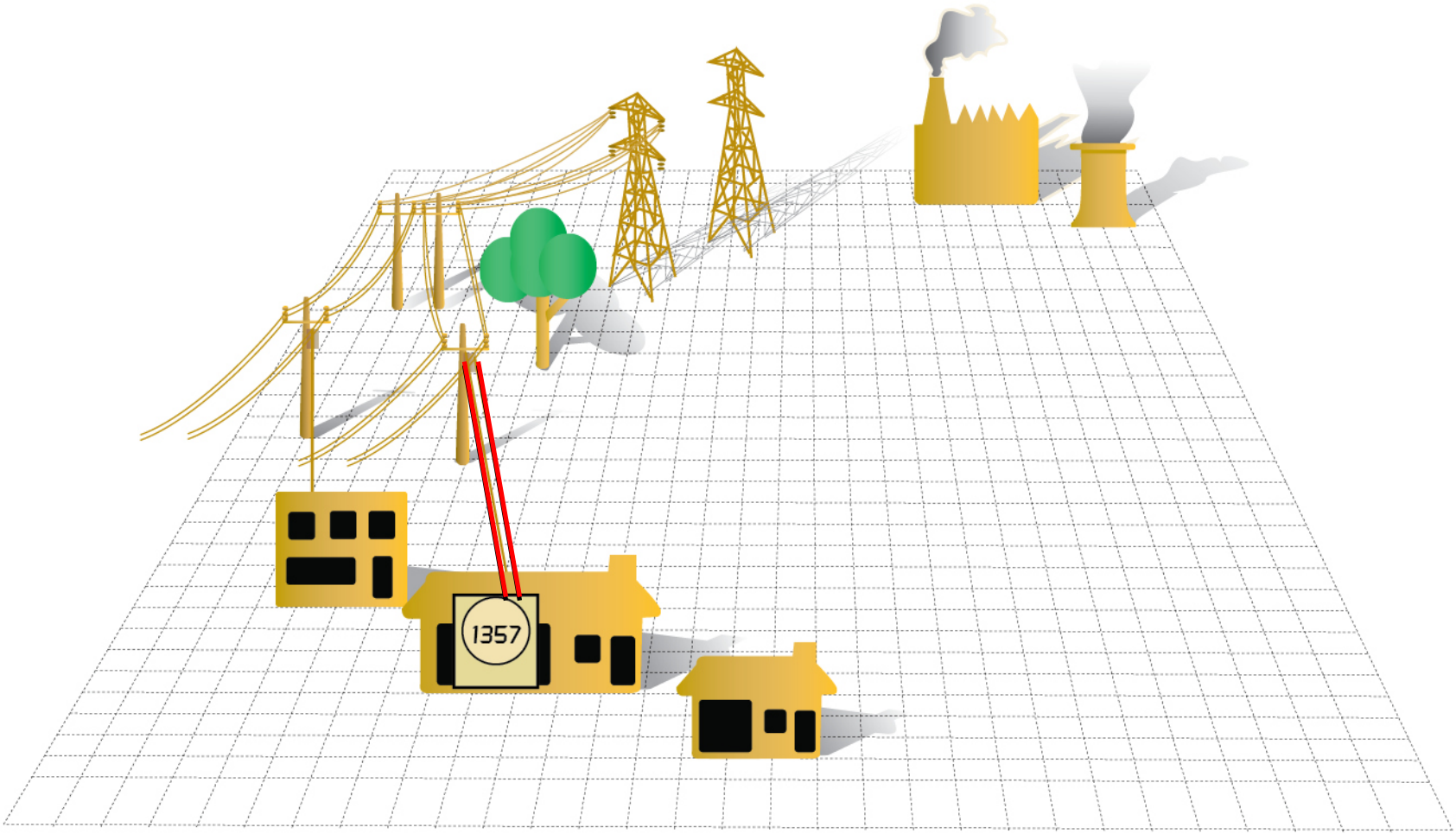


Smart Grid Vision

Create a digital communication path to enable information flow for operation and control of the efficient production, transportation and use of energy.



Smart Meters



Smart Meters

Requirements

- Two-way digital communication between host and meter to provide:
  1. Interval meter data
  2. Real-time price support
  3. In-home two-way communications
  4. Remote connect/disconnect

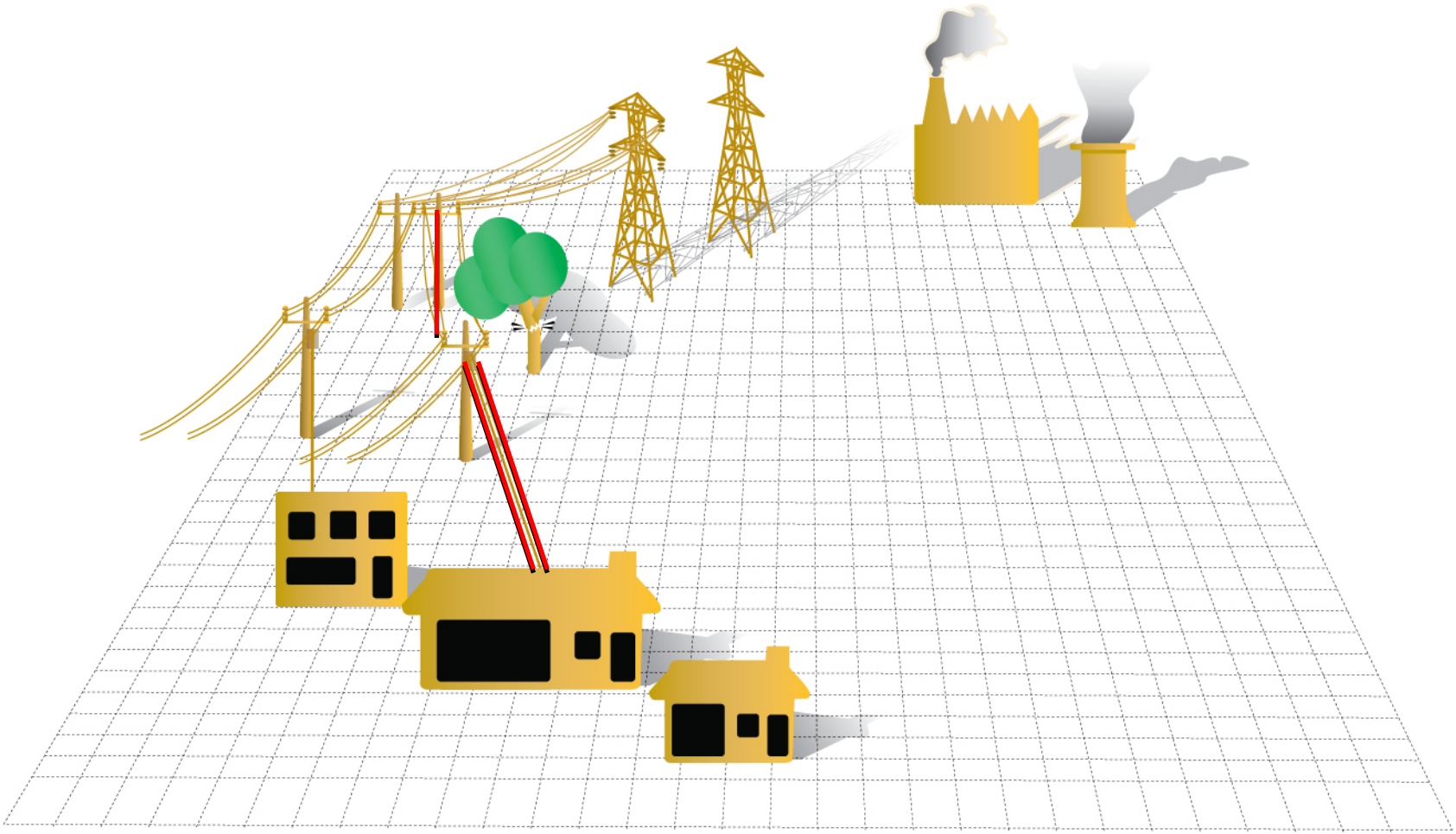
Benefits

- Demand response
- Energy efficiency
- Smart homes
- Less generation
- Savings justify the cost of infrastructure

Smart Meters – Outcome

- Little change in utility structure
- Significant gains in load smoothing
- Most control handled by utility with more information provided to customers
  - More knowledge of their consumption
  - Consumers begin to become more active participants
- Improved operating efficiency
- Savings support further grid enhancements

The Intelligent Grid



Intelligent Grid

Requirements

- Need to meet ever-increasing customer expectations of reliability and power quality
- Need to care for aging infrastructure

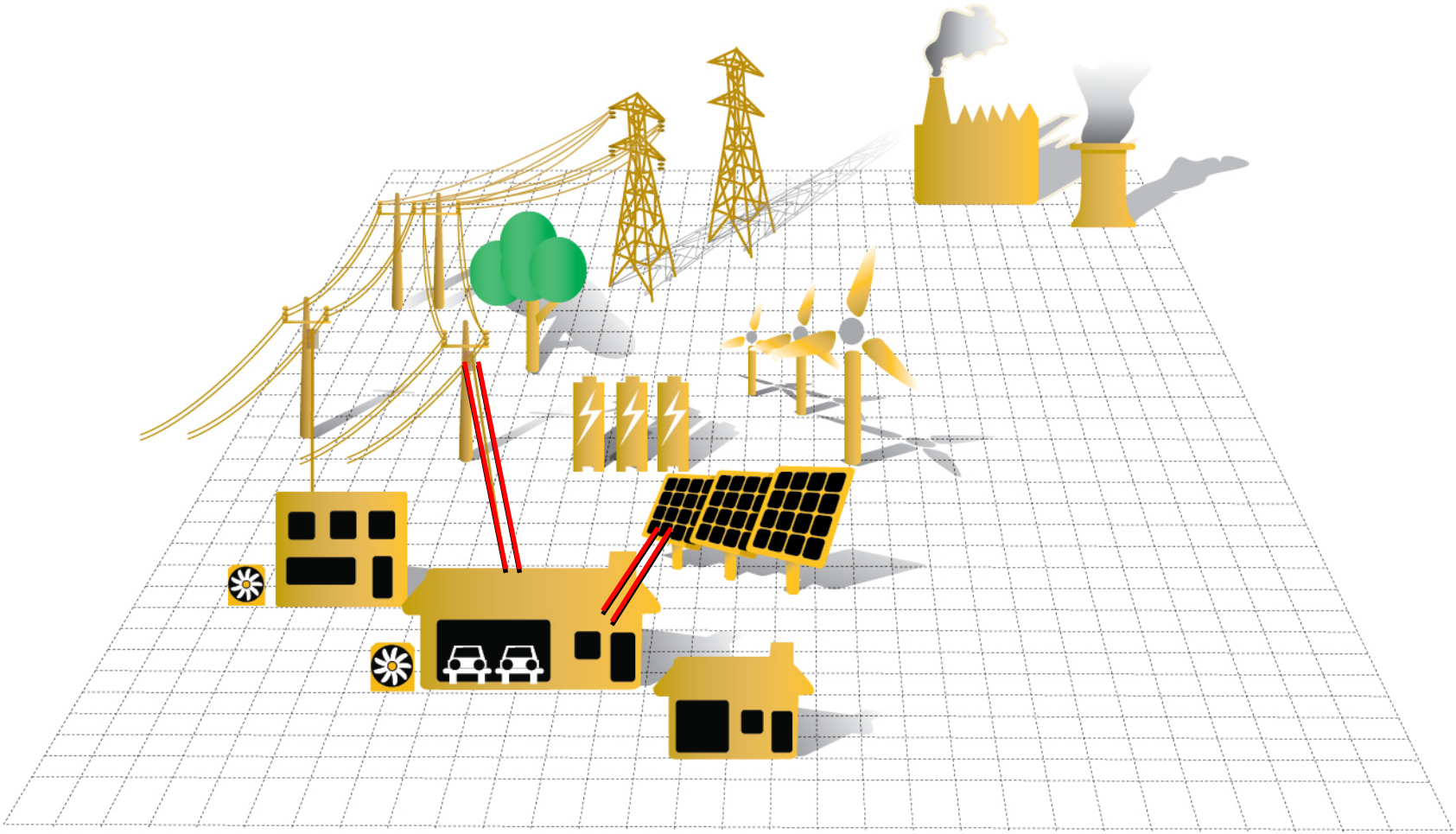
Benefits

- Improved power quality and reliability
  - Self-healing grid
  - Improved fault detection
  - Diagnostics for outage prevention
- Optimized life of electrical assets
- Help offset decline in workforce
- Reduced costs

Intelligent Grid – Outcome

- Still a utility-centric paradigm
- Improved system reliability
- Improved outage response
- Improved customer satisfaction
- Extended life of electrical assets
- Operational improvements
- Savings
- The foundation is set for utility transformation

Distributed Generation



Distributed Generation

Requirements

- Market drives requirements
- Need to address rising consumer costs
  - Energy
  - Transportation (PHEVs)
- Connecting distributed generation to the grid

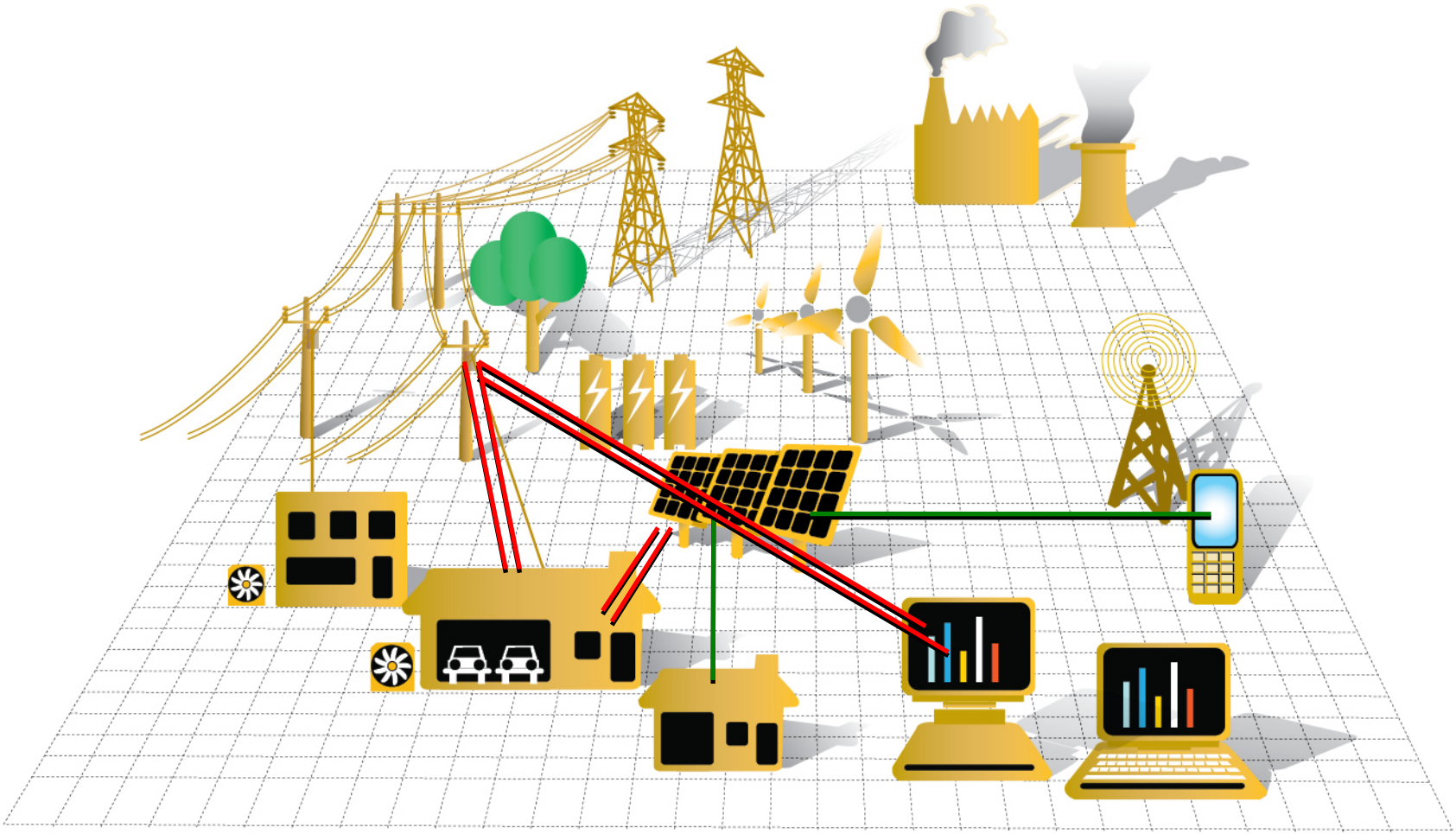
Benefits

- Real demand response
- Time-of-day response
- Environmental benefits

Distributed Generation – Outcome

- High energy prices and environmental awareness awaken consumers to alternative energy choices
- Utility-centric paradigm shifts to the consumer
- Empowerment of power-generating consumers
- The grid doesn't disappear, but …
- … it begins to operate in a new way

The Virtual Utility



The Virtual Utility

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Requirements

- Willing participation in creation of user-friendly Internet solutions
- Seamless integration
- Plug-and-play compatibility
- Consumers must be more interactive participants
- Power sharing

Benefits

- Expansion of market-driven energy services
- Energy efficiency
- Environmental benefits
- Benefits shared across the energy chain among utilities and non-utilities
- Consumers better understand and control their energy usage
- Smart homes

The Virtual Utility – Outcome

- The Virtual Utility is the outcome of the convergence of Smart Meters, the Intelligent Grid and Distributed Generation
- Deconstruction of the old paradigm – the utility is no longer in control
- Consumers choose automated or manual energy management
- The market takes over, drives solutions
- Market solutions close gap of consumer expectations

Obstacles

- Expense
- Scope of technology change
- Resource strains
- Time is not our friend
  - Aging workforce
  - Aging infrastructure
  - Rising consumer expectations
- Cultural barriers

Obstacles

- Short-term thinking
- Inability to imagine the new virtual utility paradigm
- Lack of collaborative spirit
- Lack of coordinated R&D b/w utilities and vendors
- Lack of standards, definitions, interoperability
- Unwillingness to deconstruct the paradigm

Solutions

- Cost may slow project, not stop it
- Assess cost of not automating
- Holistic, not piecemeal approach
- Capture institutional knowledge
- Spread the vision, let go of fear, embrace the future

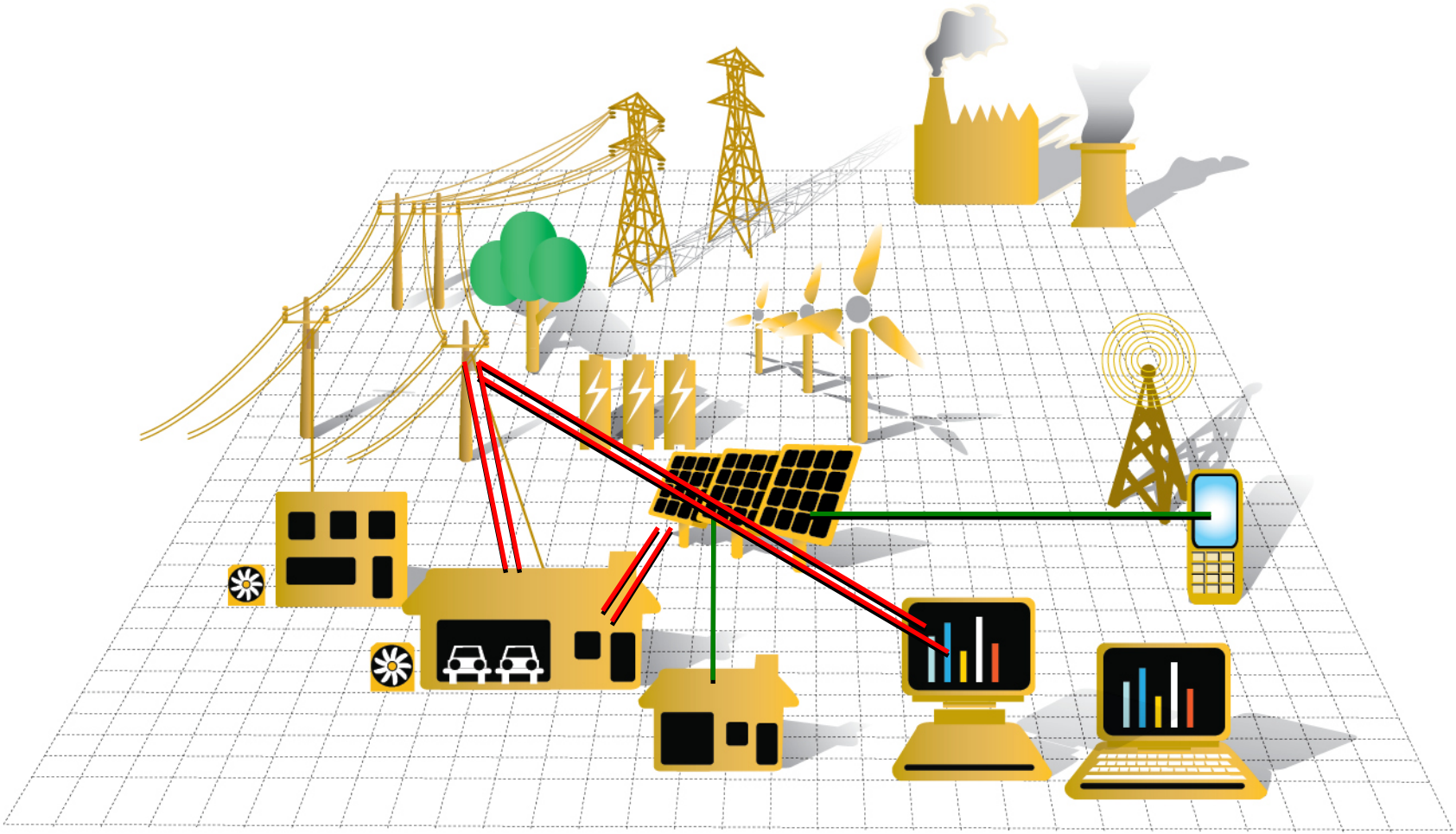
Solutions

- Develop a roadmap
- Take the APQC survey
- Mandates and the market drive solutions
- Collaboration
- Willingly participate in user-friendly solutions
- National standards
- Shape the future before it shapes us

The Virtual Utility

- Digital communications ignites the transformation
- Realization of the Home Area Network
- Deconstructing the old paradigm
- Growth opportunities are non-traditional
- Collaborative management of the market
  - Generators
  - ISOs
  - REPs
  - TDUs
  - Vendors
  - Consumers
- Utilities that quickly adapt will be most successful

The Virtual Utility – a final challenge



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QUESTIONS?